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(71) Applicant *(for all designated States except US)*: ASCOM NORDIC A/S [DK/DK]; Park Allé 295, DK–2605 Brøndby (DK).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: ELLGAARD, Torben [DK/DK]; Buddingevej 346, DK–2860 Søborg (DK).

(74) Agent: PLOUGMANN, VINGTOFT & PARTNERS A/S; Sankt Annæ Plads 11, P.O. Box 3007, DK–1021 Copenhagen K (DK).

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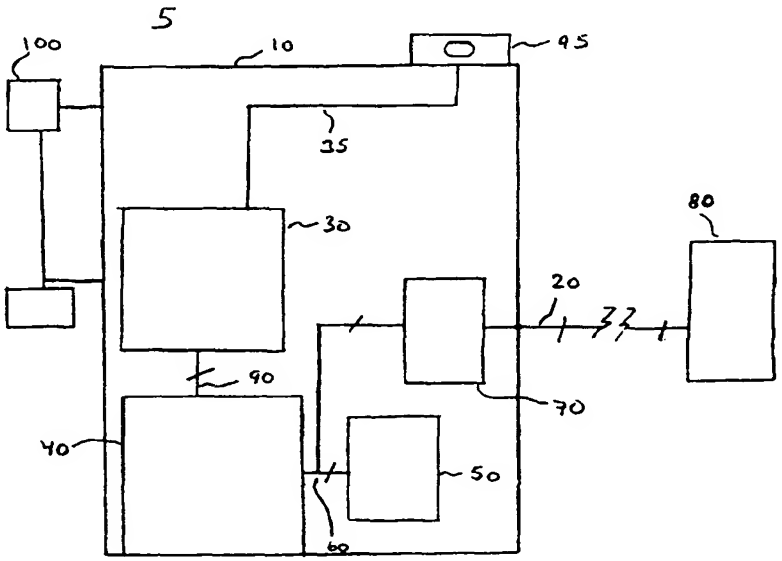

(57) Abstract

An apparatus for receiving and accepting tokens, such as coins or notes, the apparatus performing a calibration to a new type of token at its position of normal use. During the calibration, tokens of the new type are used for narrowing criteria used for accepting or rejecting tokens of the new type. The initial criteria are downloaded from a remote computer, and the calibration is performed on tokens inserted by users during normal operation. The user is not able to see that the apparatus is performing a calibration, as the apparatus performs the service upon acceptance of a token of the new type. Also, in order to prevent or reduce fraud, the apparatus may be instructed to not use all accepted tokens of the new type for the calibration. In order to further check that the calibration is correct, the apparatus may comprise means for holding at least those tokens of the new type having been used in the calibration.

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AN APPARATUS FOR RECEIVING AND ACCEPTING TOKENS

The present invention relates to an apparatus for receiving and accepting tokens and especially to an apparatus, which may be, remote controlled to accept tokens not previously accepted by the apparatus.

Apparatus of the present type are typically apparatus performing a service, such as pay phones, performing the service after insertion and acceptance of a coin.

Normally, apparatus of this type have a part generating parameters relating to tokens received thereby. These parameters are compared to criteria, which the parameters of a given token are to fulfil, before the token is accepted. Different types of tokens, such as coins with different monetary values, normally have different parameters and therefore different criteria.

In apparatus of this type, the parameters derived from a given token will differ between apparatus, as the measurements or derivations of these parameters normally comprise an uncertainty relating to the manufacturing processes used for manufacturing the apparatus. Such differences may stem from mechanical uncertainties in the positioning or manufacturing of the parts defining the positions where the measurements are performed at the tokens, or the parts of the apparatus performing these measurements.

In order for an apparatus to be able to correctly accept a token of a given type and still reject tokens of non-acceptable types (and to be able to determine which type of token has been received), the criteria which the parameters should fulfil therefore have to be generated for each individual apparatus. Otherwise, too broad criteria, which could otherwise be used in a number of apparatus, might be so broad that not acceptable tokens are accepted by some of the apparatus (but not by others).

Naturally, such differences could be avoided or sufficiently reduced by tightening the manufacturing process in order to have all apparatus measure or provide the same parameters for tokens. This, however, vastly increases the manufacturing cost of the apparatus.

Instead, it has been until now accepted that each individual apparatus requires individual calibration at the factory for each type of token. This, however, incorporates the disadvantage that if the

apparatus subsequently, when positioned at its operating position in the field, has to be able to accept a new type of token, a standard calibration can not be used.

Therefore, normally when apparatus of this type are to be calibrated to accept a new type of token, the apparatus, or at least the part thereof evaluating the token, is brought to a central location where a number of tokens of the new type are introduced in the apparatus or part thereof in order to generate or provide parameters for these tokens. These generated parameters are subsequently used for calculating or generating the criteria for use in that specific apparatus for that specific new type of token, where after these criteria are fed to the apparatus. This, however, is a labour intensive step, which also removes the apparatus from their operating positions or renders these inoperative during calibration.

An alternative way is to have a trusted person visit and calibrate all apparatus at their sites of operation using a set of calibration tokens.

Apparatus of those types may be seen in WO 97/27567, US-A-5,067,604, EP-A-0 395 067, GB-A-2 293 039, GB-A-2 199 978, EP-A-0 328 441, WO 94/04998, and US-A-4,538,719.

The present invention addresses this problem, and in a first aspect, the invention relates to an apparatus for performing a service upon receiving and accepting a token, the apparatus comprising:

- means for receiving a token,
- means for deriving one or more parameters relating to the token,
- storing means for holding criteria relating to the derived one or more parameters, and
- means for accepting the token based on a determination of whether the derived one or more parameters fulfil the criteria,
- means for receiving initial information comprising initial criteria relating to parameters of tokens of a new type of token,
- means for, on the basis of the initial criteria, generating final criteria on the basis of subsequently derived parameters relating to a number of subsequently received tokens of the new type of token, the final criteria being more restrictive than the initial criteria, and
- means for transferring the final criteria to the storing means, so as to adapt the accepting means to subsequently accept a token of the new type of token, when derived parameters relating thereto fulfil the final criteria,

where the apparatus is adapted to perform the service in response to receiving and accepting each of the number of subsequently received tokens of the new type of token.

In this manner, a standard calibration may be provided and transmitted to a number of apparatus, where after, in each apparatus, an apparatus specific calibration is performed on the basis of parameters derived by the specific deriving means - parameters derived from a number of subsequently received tokens of the new type.

Having performed this calibration, subsequently received tokens of the new type will be accepted, if the parameters thereof fulfil the final criteria

However, as the apparatus performs the service expected by the user, the user of the apparatus will not note that the apparatus is, in fact, in the process of being calibrated to the new type of token. The only difference is that the apparatus may, during this process, accept tokens, which might not be accepted, when the apparatus is fully calibrated. This is not possible for the user to notice.

Thus, performing the service will make the users think that the apparatus has already been calibrated, and fraudulent attempts to diverge the calibration will be prevented or at least greatly reduced. Also, a certain amount of fraud or monetary loss may be accepted due to the large savings on manpower relating to the previous labour-consuming manner of calibrating the apparatus.

In the present context, a new type of token is a token, which was not acceptable by the apparatus at the time of receipt of the initial information relating to that type of token.

Also, narrower criteria means criteria which, compared to the wider criteria, are fulfilled by a relatively smaller number of tokens of a given type, where the tokens have differing parameters.

Preferably, the criteria comprise a number of intervals, the means for accepting the token being adapted to accept the token, if the derived parameters lie within the intervals. Normally, there will be one interval for each derived parameter, and the token will only be accepted if all parameters lie within their respective intervals.

Thus, the initial criteria suitably comprise a number of initial intervals of initial sizes, and wherein the generating means are adapted to narrow the initial intervals - such as to final intervals of predetermined widths.

Alternatively, the criteria may specify a relation, which should exist between the parameters in order for the token to be acceptable.

Normally, the apparatus will be adapted to receive and accept not only a single type of token but a number of types at the time of calibration to yet another type of token. Thus, preferably

- the receiving means are adapted to receive tokens of a number of predetermined types,
- the deriving means are adapted to derive one or more parameters relating to tokens of the predetermined types, the parameters relating to one type of token being distinguishable from those relating to another type of token, and preferably
- the storing means are adapted to hold criteria relating to derived parameters from each of the number of predetermined types of tokens.

A number of different schemes may be derived for the generation of the final criteria. The main feature is that parameters relating to a number of tokens of the new type are used in the apparatus specific calibration.

In one situation, the generating means may be adapted to generate the final criteria on the basis of parameters derived from subsequently received tokens, the number of which is less than a total number of subsequently received tokens of the new type of token. In this situation, it should be determined which of the subsequently received tokens are to be used in the generation of the final criteria. This determination may be a stochastical selection - or tokens with a predetermined spacing - such as every third token - may be selected.

This is especially desired, when the tokens represent a monetary value and where it is to be ensured that fraud is avoided or made difficult during this non-supervised calibration. If a fraudulent person does not know which of the subsequently received tokens will be taken into account in the calibration, a larger number of tokens have to be "spent" in order to e.g. force the apparatus into accepting fraudulent tokens having parameters fulfilling the initial criteria but not final criteria as these would have been derived using tokens of the correct, new type.

Alternatively, the generating means may be adapted to generate the final criteria on the basis of parameters derived from subsequently received tokens, the number of which is at least substantially equal to a total number of subsequently received tokens of the new type of token. In this situation, no selection may be required.

A further alternative or option is one wherein the generating means are adapted to generate the final criteria on the basis of parameters derived from a predetermined number of subsequently received tokens of the new type of token. This number of tokens will depend on the desired precision of the calibration or the expected variation of the parameters of the tokens. Normally, parameters from at least 10 tokens, such as at least 50 tokens, preferably at least 100 tokens, such as 100-200 tokens are used in the calibration.

Optionally, the calibration may proceed until the criteria have been altered to a given degree compared to the initial criteria. In the situation where the criteria are represented by intervals, the calibration may proceed until all intervals are reduced to a given degree or to predetermined widths.

An especially preferred embodiment is one where the apparatus needs not be removed from its position in order for it to be calibrated. In a situation of that type, the means for receiving the initial information preferably comprise means for communicating with a remote computer means generating or providing the initial information.

In that situation, it may be preferred that

- the generating means comprise a controlling means adapted to perform actions defined by a set of instructions,
- the generating means are controllable by the controlling means,
- the remote computer is adapted to generate or provide the set of instructions, and that
- the means for receiving the initial information are adapted to receive the set of instructions and forward these to the controlling means.

When the remote computer is adapted to generate the set of instructions, the calibration is remote controllable to a degree where new schemes, for e.g. selecting which of subsequently received tokens are to be used in the calibration, may be subsequently devised and programmed centrally. Also, the manner in which the initial criteria are narrowed into the final criteria may be devised and altered without having to remove the apparatus from their operative positions.

In a simpler embodiment, the set of instructions may be parameters for use in a more fixed calibration procedure taking place in the apparatus. Parameters of this type may specify the number of tokens to be used in the calibration, how, if applicable, to select these from those received, how to reduce the initial criteria to the final criteria - and any demands put on to the final criteria. Also that

calibration may be performed with the apparatus in its operative position. The possibility to calibrate the apparatus in its operative position, has several advantage over the existing factory calibration. There is no need to remove the apparatus, or at least a part of it, and transport it to the factory. Since the users of the apparatus are supplying the tokens used for calibration during normal operation, a large number of tokens can be used in determining the correct final criteria, and thus giving a better confidence.

More specifically, the remote computer may be adapted to generate or provide, in the set of instructions, instructions relating to

- a subsequent number of subsequently received tokens of the new type of token, and/or
- information relating to which of the subsequently received tokens of the new type of token, the parameters of which are used by the generating means in the generation of the final criteria.

The remote computer may be adapted to generate or provide the initial information comprising initial criteria determined on the basis of parameters derived from a number of tokens of the new type of token having been introduced into one or more means for deriving one or more parameters relating to the tokens. In that situation, the initial criteria may be derived in a manner so as to be sufficiently broad to take into account the variation of the parameters of the tokens of the new type and the variation of the derived parameters due to manufacturing variations of the deriving means of the apparatus. In that situation, the one or more means for deriving the one or more parameters may be selected at the factory due to their standard or typical responses and retained for subsequent initial calibration of the remaining means which are used in the field.

Depending on the actual generation of the final criteria on the basis of the initial criteria, the generating means may be adapted to generate the final criteria in a number of steps, where the tokens of the new type received subsequently to the receipt of the initial information are received over a period of time during which the steps take place, each step being performed on the basis of parameters derived from previously received tokens.

In that situation, the generating means may be adapted to, in a step, generate intermediate criteria representing criteria more narrow than the initial criteria and broader than the final criteria. In that manner, the criteria relating to the new type of token gradually approach the final criteria.

In one embodiment, the accepting means are adapted to accept tokens of the new type of token (subsequent to that step and before the next step), if parameters derived from a received token of the

new type fulfil the intermediate criteria, and wherein the generating means are adapted to perform a subsequent step of the generation of the final criteria on the basis of the parameters derived from the accepted token of the new type.

In that situation, the criteria gradually narrow, and only tokens of the new type fulfilling the gradually narrowing criteria are accepted and used in the subsequent steps in the calibration. In that manner, the criteria, which the tokens of the new type are to fulfil, are restricted gradually, as knowledge is obtained relating to the actual read-outs of the deriving means.

In another embodiment, the decision to use or discard parameters from a received token fulfilling the intermediate criteria, in the generation of the next intermediate criteria, can be made to depend on how close the parameters of the received token are to a current statistical measure of the parameters. It is preferred to use a median estimate as the statistical measure of a parameter. By comparing a parameter of the received token with its median estimate, a decision is made to either use or discard the parameter value in the calculation of the next intermediate criteria. In one situation the decision is derived from the median estimate, the parameter, and a predetermined value. The decision making property described above is a special case of utilising a general function to derive a weight factor for the current parameter value, and use this weight factor in the calculation of the next intermediate criteria.

Alternatively, the generating means may be adapted to generate the final criteria in a single step. In that manner, the parameters relating to the all required subsequently received tokens of the new type are firstly derived, where after the generation of the final criteria takes place.

It should be noted that the present apparatus may be used for receiving and accepting any type of token. However, the most widely used apparatus of that type would be one used for tokens representing a monetary value, such as coins or notes.

The parameters derived from the tokens and used in the determination of whether the tokens are acceptable will depend on the actual token. Naturally, the parameters should be ones varying between the types of tokens.

For example, the new type of token may be a token having, compared to previously acceptable tokens, a different

- physical size, such as a different weight, thickness, width, height and/or diameter,

- monetary value,
- electrical and/or magnetic properties,
- composition of the material forming the token, such as a different alloy, metal, paper quality and/or
- optical properties, such as a different reflection, transmission or fluorescence, such as at one or more predetermined wavelengths,

and/or wherein the tokens of the new type do or do not have a watermark and/or other characteristics, such as indentations, recognisable outer contours, and/or embedded characteristics, such as metal wires.

In order to further prevent or reveal fraud, the apparatus preferably further comprises means for holding received tokens.

Especially when the holding means are adapted to store those tokens of the new type of token the parameters of which are used by the generating means, it is firstly ensured that the same token cannot be used repeatedly and thereby "misguide" the calibration into assuming that the variation of the parameters of the tokens of the new type is very small, and secondly, fraudulent or incorrect tokens used for misguiding the calibration will be revealed when collected.

An alternative or optional manner of revealing or preventing fraud would be one wherein the apparatus is adapted to forward information relating to the final criteria to the remote computer, when the final criteria have been generated. In this manner, it may be evaluated whether the final criteria could have been obtained by using tokens of the new type or whether the final criteria deviate sufficiently for it to be possible that they may be obtained by using other tokens. In that manner, the apparatus may be "reset" by annulling the previous calibration relating to the new type of token and provided with initial information in order to start a new calibration.

Apparatus according to the invention comprise pay phones and pay terminals used at gas stations or for offering other products for sale. In those situations, the means for performing the service are means for enabling a user to perform a telephone conversation or means enabling a user to purchase gas or other products.

In a second aspect, the invention relates to a method of updating an apparatus as those mentioned above, the method comprising:

- receiving the initial information and deriving therefrom the initial criteria,
- during or subsequent to receipt and acceptance of a number of subsequently received tokens of the new type and derivation of parameters relating thereto, narrowing the initial criteria to generate final criteria, and
- subsequent to acceptance of a token of the new type, performing the service.

Preferably, the generation of the final criteria is obtained in a number of steps wherein intermediate criteria are generated which are narrower than the initial criteria and broader than the final criteria.

In that manner, the intermediate criteria relating to a step may be generated from the intermediate criteria relating to a previous step and parameters derived from one or more received tokens of the new type which fulfil the intermediate criteria relating to the previous step.

Also, the method may comprise generating, at a location remote from the apparatus, the initial information comprising the initial criteria and additional information for controlling the generation of the final criteria, where the initial criteria may be generated on the basis of parameters provided by inserting a number of tokens of the new type of token into at least one means for providing parameters.

The generation of the final criteria may be based on parameters derived from a predetermined number of subsequently received tokens of the new type, or the generation of the final criteria may be based on parameters derived from a subset of the subsequently received tokens of the new type, where the tokens of the subset of the subsequently received tokens can be selected randomly from the subsequently received tokens.

As described above, preferably the method further comprises the step of holding those of the tokens of the new type the derived parameters of which are used in the generation of the final criteria.

The invention will now be described with reference to the drawing, wherein
Fig.1 is a schematic view of a pay phone according to the preferred embodiment of the invention.

Fig.1 diagrammatically illustrates the key components of a pay phone 5 set to operate according to the invention. The outer housing 10 of the pay phone contains a coin check unit 30, a modem circuit 70, a MPU system 40, an EEPROM memory device 50 connected to the MPU system 40 through a

data line 60. The pay phone 5 is connected to the telephone network with the line cable 20. The line cable 20 is also connected to a remote facility computer 80. A handset 100 and a coin inlet 95 are provided for the pay-phone user.

During normal operation of the pay phone 5, the line cable 20 is used to transmit a voice signal from the person using the handset 100 to make an ordinary phone call. The line cable 20 is also during quiet periods typically at night, utilised to transmit data information regarding the current operation status of the payphone 5 to the remote facility computer 80, by utilising the modem 70. This ensures that the condition of a large number of pay phones can be monitored from the central facility computer 80, and it ensures that an error or a need for maintenance occurring on any pay phone 5 is quickly detected. The data transmitting capability of the pay-phone 5, likewise makes it possible for the remote computer 80 to transmit data to the pay-phone 5, and this possibility is used in the present invention to adapt the pay-phone 5 to accept new coin denominations.

The MPU system 40 comprises a microprocessor (not illustrated) which controls the operation of the coin check unit 30. The microprocessor loads an operation program from the EEPROM 50 through data line 60, and this operation program is responsible for the functions of the coin check unit 30.

The importance of the invention can best be understood by explaining the combined role of the operation program and the coin check unit 30 in determining whether a coin inserted in the inlet 95 is valid. The technical details of the coin check unit 30 is described in detail in EP-A-224946 from Alcatel Kirk AS, and a summary of the key features is included here for the purpose of describing the preferred embodiment of the present invention.

The coin runs through a channel 35 to the coin check unit 30. The coin check unit 30 includes a coin measurement unit, which contains two magnetic coupled coils physically arranged to lie on the same longitudinal axis with a narrow air gap between them. The air gap is suitable for the passage of a coin runway.

One coil is used as a transmission coil and is supplied with a 32 kHz sine wave signal from an oscillator. The sine wave signal is transmitted to the second coil by means of a mutual magnetic coupling between the coils.

When a coin enters the passage between the coils, a change occurs in the magnetic coupling between the coils due to the magnetic properties of the coin. The change in coupling is measured by detecting

the magnitude of the 32 kHz sine wave signal on the secondary coil. By measuring the magnitude of the 32 kHz signal on the secondary coil at four different positions of the coin on the runway, characteristic values for a specific coin denomination are obtained. The four different positions, at which the magnetic coupling measurement takes place, are defined by four LED's and four phototransistors arranged along the coin runway, each LED and phototransistor being positioned on opposite sides of the runway, and being positioned just before the coin enters the air gap between the coils. By detecting the presence or absence of light in each of the channels defined by the LED and phototransistor arrangement, an inductive measurement is triggered at known positions of the passing coin. Five values are extracted from the four measurements, since a measurement of the minimum coupling between the coils is performed along with the four measurements of coupling at the positions mentioned above. The five measurement values P1, P2, P3, P4, P5 are coin parameters which are specific for a coin denomination. The coin parameters P1 - P5, which are the results of a passing coin, are latched in a register in the coin check unit 30, and the register is accessible by the CPU contained in the MPU system 40, by means of data line 90.

The role of the operation program in the MPU system 40 is to read the five coin parameters P1 - P5 obtained during the coin measurement procedure and compare the parameters with values contained in a coin table in the EEPROM 50. The operation program accepts the coin as valid, if P1 - P5 all fit within corresponding parameter intervals or acceptance windows around the parameter mean values for a given coin denomination. The mean value and acceptance window for each parameter P1 - P5, for each coin denomination in the coin table, have previously been found during a calibration procedure of the coin check unit 30 at the factory. The calibration procedure has to be carried out on each coin check unit 30, due to a unit to unit random variation in measurement results from a given population of coins. The variation in measurement results is the result of production tolerances on the coin check unit 30, which include: sensitivity of LED's, phototransistor sensitivity, magnetic coupling between coils, mechanical tolerances.

The correct mean values and acceptance windows for each coin denomination on a specific coin check unit 30 have previously been obtained by inserting a known coin population in each unit 30, recording the readout values, transferring the values to a PC program for statistical analysis, and letting the PC program calculate suitable mean values and acceptance windows for the unit 30 in question. The calculated mean values and acceptance windows for a coin denomination are finally transferred to the coin table in the EEPROM 50.

The previous calibration procedure had a serious drawback, since every time the pay-phone 5 had to accept a new coin denomination, it was necessary to remove the coin check unit 30 physically from each pay-phone 5, bring the unit 30 to the factory, and perform the above described calibration procedure.

It is a feature of the present invention that the operation program in the MPU system 40 includes a sub-program, which in the preferred embodiment can be activated from the remote facility computer 80. The sub-program performs a dynamic calibration of the coin check unit 30 in order to make the pay phone 5 accept a new coin denomination.

An initial coin table for the new coin denomination, which the pay-phone 5 has to accept, is transmitted from the remote facility computer 80 to the MPU system 40, and the dynamic calibration sub-program is activated. This initial coin table has wider acceptance windows for coin parameters of the new coin denomination than the ordinary acceptance windows obtained by the described factory calibration procedure. The wider windows are necessary due to the unit-to-unit random variation on measurement values of coin parameters.

The preferred embodiment of the dynamic calibration procedure, which is performed by the sub-program, is described in detail now:

The initial coin table and the calibration algorithm uses the following variables:

MEDIAN is a byte holding the current value of the median for a coin parameter.

COUNT is a 2 byte variable holding the current number of coins that have passed the window defined by TRACKWIN.

FLAG is a 2-byte variable storing possible MEDIAN adjustments of all parameters P1 - P5, until the next coin is cashed. A total of 5 FLAG variables are used.

ADJUST is a byte variable containing a signed counter for a coin parameter.

MINWIN is a byte variable for a coin parameter, in which byte the 4 MSB represent the minimum allowed distance from the MEDIAN to the upper limit of the acceptance window, and the

4 LSB represent the minimum distance to the lower limit of the acceptance window. So, the acceptance window for a coin parameter is never allowed to be narrower than the sum of the values represented by these bits.

TRACKWIN is a byte variable, which holds the width of the acceptance window for a coin parameter. TRACKWIN is centred around the current value of the variable MEDIAN. The measurement value of a coin parameter, has to be within this window to affect an adjustment of the MEDIAN.

THRESHOLD is a byte variable, its value determines whether a given value of ADJUST will trigger a movement of the MEDIAN.

MINCOUNT is a byte. A number of approved coins larger than this variable has to be inserted in a coin check unit 30 before a boundary movement of the acceptance window is approved.

STOPCOUNT is a byte. The calibration procedure terminates when this value has been reached for variable COUNT.

MIN, MAX is the smallest and the largest value respectfully of a coin parameter in the coin table. The difference between MIN, MAX is the width of the acceptance window for the coin parameter. The values of MIN and MAX are altered dynamically during the calibration procedure in order to make the acceptance window narrower.

<u>The calibration algorithm for one variable P1:</u>

MEDIAN-P1:= MIN + (MAX - MIN)/2

Initialise coin module: Reset FLAG and ADJUST

Coin measured, P1 value results. Coin in escrow.

Check MIN < P1 < MAX, if yes
Coin to escrow
if no
Return coin(counterfeit)

Check MEDIAN - TRACKWIN(low nibble) < P1 < MEDIAN + TRACKWIN(high nibble), if yes

Compare P1 and MEDIAN-P1 and set FLAG bits for P1-adjust Up/down accordingly

If no

No FLAG set

Cash coin when due

Take the relevant bit settings(P1) of all used FLAG variables and count ADJUST-P1 up/down according to bit settings.

Reset all FLAG variables.

Check |ADJUST-P1| > THRESHOLD-P1 if true,

MEDIAN-P1:= MEDIAN-P1 +/- 1 according to sign of ADJUST-P1

If false, MEDIAN-P1:= MEDIAN-P1

COUNT = COUNT + 1

Check COUNT/MINCOUNT = Integer value, if yes

{Check MEDIAN - MINWIN(low nibble) >= MIN, if yes

MIN:= MIN + 1

Write new MIN to EEPROM

If no,

MIN:= MIN

Check MEDIAN + MINWIN(high nibble) <= MAX, if yes

MAX:= MAX - 1

Write new MAX to EEPROM

If no,

MAX:= MAX}

if no,

Check COUNT = MAXCOUNT, if yes

End calibration

If no

Await new coin

END.

Comments to the calibration algorithm:

In order to minimise memory usage and the calculation burden placed on the MPU system 40, all variables in the calibration procedure are represented as integer numbers. The calculation of the mean value for the five parameters P1 - P5, is altered to be a calculation of the median values of the parameters in order to simplify the calculations.

The use of the TRACKWIN ensures that only coins, which parameter values are reasonably close to the current median estimates, are used in the adjustment of the medians. This ensures that a large number of counterfeit coins with parameter values close to MIN values or MAX values, are not used to move the MEDIAN value in a wrong direction.

The intermediate storage of parameter measurements in the FLAG bytes until a coin is actually cashed, is a precaution against pay-phone users who might insert counterfeit coins in the pay phone 5 during calibration. When inserted coins are in the escrow, their parameters P1 - P5 have already been measured and stored in the FLAG bytes, but the FLAG settings will only have an effect in the calibration algorithm, if the coins are actually cashed.

When the preset minimum value for the width of the acceptance window, defined by means of MINWIDTH, has been reached, the dynamic calibration sub-program has completed its task. The modified values for variables MIN and MAX of parameters P1 - P5 in the coin table are stored permanently in the EEPROM 50.

The control of the pay phone 5 is transferred back to the main part of the operation program, and the pay phone 5 accepts the new coin denomination.

The coin table acceptance window width for the new coin denomination, at the end of the dynamic calibration procedure, has been contracted to the final value defined by variable MINWIDTH. This

final value for the acceptance window width is equal to the window width found by the traditional factory calibration procedure, and thus a good rejection of counterfeit coins for the new denomination is obtained without ever bringing the coin check unit 30 back to the factory for calibration. Each pay phone 5 just has to receive a standardised file, which is sent from the remote computer 80 by means of modem 70 and line cable 20. The file contains the initial coin table and the calibration algorithm variables for the new coin denomination, and the pay-phone 5 is adjusted to the new coin denomination by means of the calibration sub-program which utilises coins inserted by the users during normal operation of the pay-phone 5, to find the correct coin parameter values P1 - P5 for each coin check unit 30.

CLAIMS

1. An apparatus for performing a service upon receiving and accepting a token, the apparatus comprising:

- means for receiving a token,
- means for deriving one or more parameters relating to the token,
- storing means for holding criteria relating to the derived one or more parameters, and
- means for accepting the token based on a determination of whether the derived one or more parameters fulfil the criteria,
- means for receiving initial information comprising initial criteria relating to parameters of tokens of a new type of token,
- means for, on the basis of the initial criteria, generating final criteria on the basis of subsequently derived parameters relating to a number of subsequently received tokens of the new type of token, the final criteria being more restrictive than the initial criteria, and
- means for transferring the final criteria to the storing means, so as to adapt the accepting means to subsequently accept a token of the new type of token, when derived parameters relating thereto fulfil the final criteria,

characterised in that the apparatus is adapted to perform the service in response to receiving and accepting each of the number of subsequently received tokens of the new type of token.

2. An apparatus according to claim 1, wherein the criteria comprise a number of intervals, the means for accepting the token being adapted to accept the token, if the derived parameters lie within the intervals.

3. An apparatus according to claim 2, wherein the initial criteria comprise a number of initial intervals of initial sizes, and wherein the generating means are adapted to narrow the initial intervals.

4. An apparatus according to any of the preceding claims, wherein

- the receiving means are adapted to receive tokens of a number of predetermined types,
- the deriving means are adapted to derive one or more parameters relating to tokens of the predetermined types, the parameters relating to one type of token being distinguishable from those relating to another type of token,

- the storing means are adapted to hold criteria relating to derived parameters from each of the number of predetermined types of tokens.

5. An apparatus according to any of the preceding claims, wherein the generating means are adapted to generate the final criteria on the basis of parameters derived from subsequently received tokens, the number of which is less than a total number of subsequently received tokens of the new type of token.

6. An apparatus according to any of claims 1-4, wherein the generating means are adapted to generate the final criteria on the basis of parameters derived from subsequently received tokens, the number of which is at least substantially equal to a total number of subsequently received tokens of the new type of token.

7. An apparatus according to any of the preceding claims, wherein the generating means are adapted generate the final criteria on the basis of parameters derived from a predetermined number of subsequently received tokens of the new type of token.

8. An apparatus according to claim 3, wherein the generating means are adapted to narrow the initial intervals to final intervals of predetermined widths.

9. An apparatus according to any of the preceding claims, wherein the means for receiving the initial information comprise means for communicating with a remote computer means generating or providing the initial information.

10. An apparatus according to claim 9, wherein

- the generating means comprise a controlling means adapted to perform actions defined by a set of instructions,
- the generating means are controllable by the controlling means,
- the remote computer is adapted to generate or provide the set of instructions, and
- the means for receiving the initial information are adapted to receive the set of instructions and forward these to the controlling means.

11. An apparatus according to claim 9 or 10, wherein the remote computer is adapted to generate or provide the initial information comprising initial criteria determined on the basis of parameters

derived from a number of tokens of the new type of token introduced into one or more means for deriving one or more parameters relating to the tokens.

12. An apparatus according to claim 10 or 11, wherein the remote computer is adapted to generate or provide, in the set of instructions, instructions relating to

- a subsequent number of subsequently received tokens of the new type of token, and/or
- information relating to which of the subsequently received tokens of the new type of token,

the parameters of which are used by the generating means in the generation of the final criteria.

13. An apparatus according to any of the preceding claims, wherein the generating means are adapted to generate the final criteria in a number of steps.

14. An apparatus according to claim 13, wherein the generating means are adapted to generate the final criteria in a single step.

15. An apparatus according to claim 13, wherein the generating means are adapted to, in a step, generate intermediate criteria representing criteria more narrow than the initial criteria and broader than the final criteria.

16. An apparatus according to claim 15, wherein the accepting means are adapted to accept tokens of the new type of token, if parameters derived from a received token of the new type fulfil the intermediate criteria, and wherein the generating means are adapted to perform a subsequent step of the generation of the final criteria on the basis of the parameters derived from the accepted token of the new type.

17. An apparatus according to claim 15, wherein the accepting means are adapted to accept tokens of the new type of token, if parameters derived from a received token of the new type fulfil the intermediate criteria, and wherein the generating means are adapted to perform a subsequent step of the generation of the final criteria on the basis of the parameters derived from the accepted token of the new type, only if the parameters fulfil criteria relating to the intermediate criteria restricted in a predetermined manner.

18. An apparatus according to any of the preceding claims, wherein the token is a coin or a note.

19. An apparatus according to any of the preceding claims, wherein the new type of token is a token having, compared to previously acceptable tokens, a different

- physical size, such as a different weight, thickness, width, height and/or diameter,
- monetary value,
- electrical and/or magnetic properties,
- composition of the material forming the token, such as a different alloy, metal, paper quality and/or
- optical properties, such as a different reflection, transmission or fluorescence, such as at one or more predetermined wavelengths,

and/or wherein the tokens of the new type do or do not have a watermark and/or other characteristics, such as indentations, recognisable outer contours, and/or embedded characteristics, such as metal wires.

20. An apparatus according to any of the preceding claims and further comprising means for holding received tokens.

21. An apparatus according to claim 20, wherein the holding means are adapted to store those tokens of the new type of token the parameters of which are used by the generating means.

22. An apparatus according to any of the preceding claims and constituting a pay phone, wherein the means for performing the service are means for enabling a user to perform a telephone conversation.

23. An apparatus according to any one of claims 1-21 and constituting a pay terminal at a gas station, wherein the means for performing the service are means enabling a user to purchase gas.

24. A method of updating an apparatus according to any of the preceding claims, the method comprising:

- receiving the initial information and deriving therefrom the initial criteria,
- during or subsequent to receipt and acceptance of a number of subsequently received tokens of the new type and derivation of parameters relating thereto, narrowing the initial criteria to generate final criteria, and
- subsequent to acceptance of a token of the new type, performing the service.

25. A method according to claim 24, wherein the generation of the final criteria is obtained in a number of steps wherein intermediate criteria are generated which are narrower than the initial criteria and broader than the final criteria.

26. A method according to claim 25, wherein the intermediate criteria relating to a step are generated from the intermediate criteria relating to a previous step and parameters derived from one or more received tokens of the new type and fulfilling the intermediate criteria relating to the previous step.

27. A method according to any of claims 24-26, the method comprising generating, at a location remote from the apparatus, the initial information comprising the initial criteria and additional information for controlling the generation of the final criteria.

28. A method according to claim 27, wherein the initial criteria are generated on the basis of parameters provided by inserting a number of tokens of the new type of token into at least one means for providing parameters.

29. A method according to any of claims 24-28, wherein the generation of the final criteria is based on parameters derived from a predetermined number of subsequently received tokens of the new type.

30. A method according to any of claims 24-29, wherein the generation of the final criteria is based on parameters derived from a subset of the subsequently received tokens of the new type.

31. A method according to claim 30, wherein the tokens of the subset of the subsequently received tokens are selected randomly from the subsequently received tokens.

32. A method according to any of claims 24-31, further comprising the step of holding those of the tokens of the new type, the derived parameters of which are used in the generation of the final criteria.

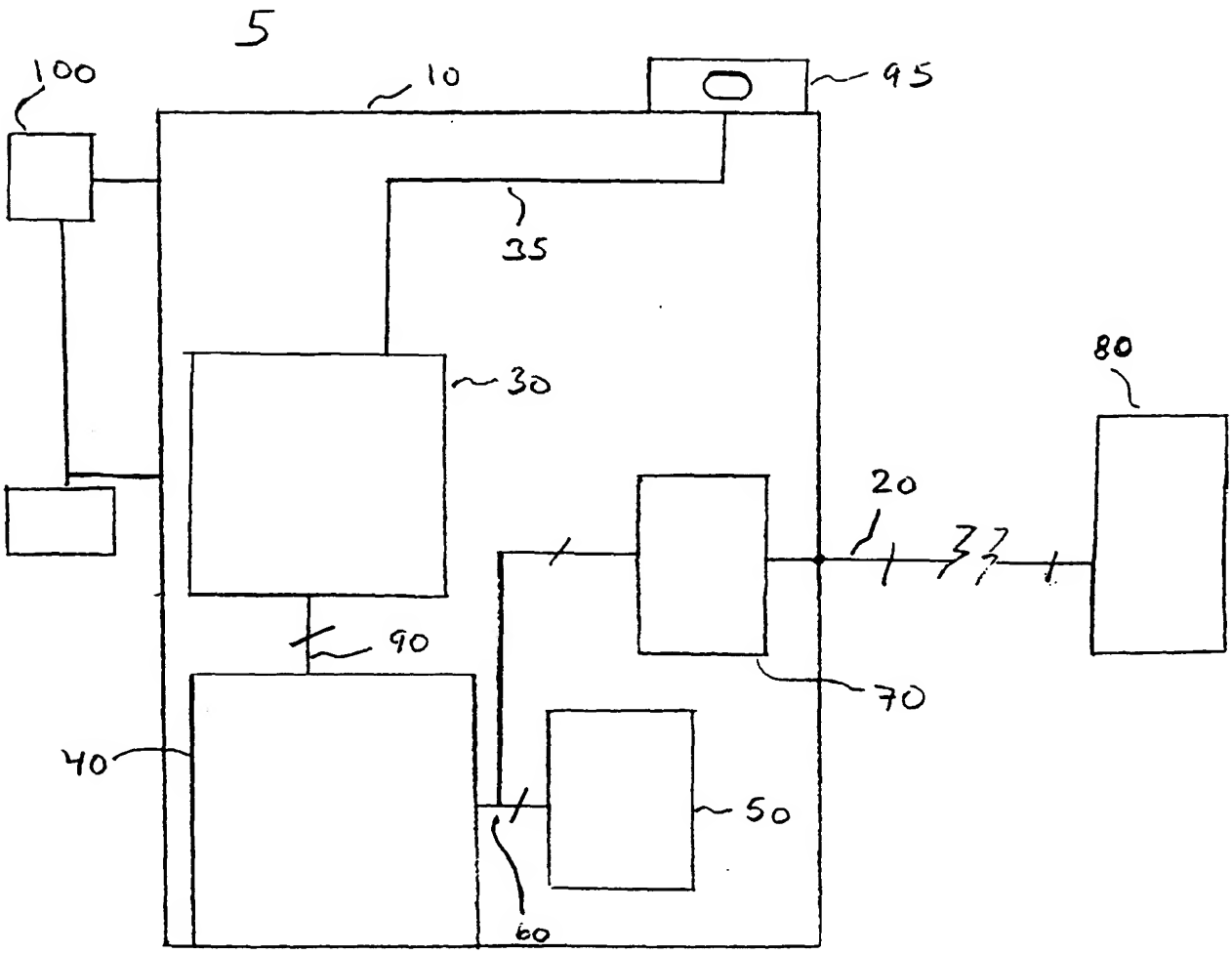

Fig. 1

SUBSTITUTE SHEET (RULE 26)

INTERNATIONAL SEARCH REPORT

In tional Application No
PCT/DK 99/00172

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07F3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07F G07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 27567 A (COIN CONTROLS) 31 July 1997 (1997-07-31) cited in the application the whole document	1-5,7-9, 11, 13-21, 24-29
A	US 5 067 604 A (S.M. METCALF) 26 November 1991 (1991-11-26) cited in the application abstract; claims; figures 3,5,6 column 6, line 47 - column 8, line 31	1,2,5,7, 9,10,12, 13, 16-19, 24-27,29

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
15 July 1999	23/07/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	David, J

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 293 039 A (MARS) 13 March 1996 (1996-03-13) cited in the application abstract; claims; figures 2,4	1-6,8, 10,13, 15-19, 24-26, 29-31
A	US 4 538 719 A (M.H. GRAY) 3 September 1985 (1985-09-03) cited in the application column 15, line 40 - column 17, line 12; figure 13 column 22, line 44 - column 26, line 24	1-8,10, 13, 15-21, 24-26, 29-31
A	EP 0 394 067 A (SANDEN CORPORATION) 24 October 1990 (1990-10-24) cited in the application	
A	EP 0 328 441 A (TAMURA ELECTRIC WORKS) 16 August 1989 (1989-08-16) cited in the application	
A	WO 94 04998 A (LANDIS & GYR BUSINESS SUPPORT) 3 March 1994 (1994-03-03) cited in the application	
A	GB 2 199 978 A (MARS) 20 July 1988 (1988-07-20) cited in the application	

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Ir ational Application No
PCT/DK 99/00172

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9727567 A	31-07-1997	AU 7702696 A	20-08-1997
		CA 2243155 A	31-07-1997
		CN 1207815 A	10-02-1999
		EP 0876657 A	11-11-1998
US 5067604 A	26-11-1991	NONE	
GB 2293039 A	13-03-1996	HK 1007053 A	26-03-1999
		AU 3397495 A	27-03-1996
		DE 69503383 D	13-08-1998
		DE 69503383 T	08-04-1999
		EP 0781439 A	02-07-1997
		ES 2117873 T	16-08-1998
		WO 9607992 A	14-03-1999
US 4538719 A	03-09-1985	NONE	
EP 0394067 A	24-10-1990	DE 69005879 D	24-02-1994
		DE 69005879 T	01-06-1994
		ES 2050949 T	01-06-1994
		KR 132564 B	01-10-1998
		US 5131518 A	21-07-1992
EP 0328441 A	16-08-1989	ES 2103260 T	16-09-1997
		JP 1302488 A	06-12-1989
		JP 2545278 B	16-10-1996
		US 4951799 A	28-08-1990
WO 9404998 A	03-03-1994	AT 147179 T	15-01-1997
		DE 59304985 D	13-02-1997
		DK 619038 T	13-10-1997
		EP 0619038 A	12-10-1994
		ES 2098044 T	16-04-1997
		FI 941690 A	13-04-1994
		GR 3022836 T	30-06-1997
		HK 1007614 A	16-04-1999
		NO 941309 A	12-04-1994
		TR 27246 A	21-12-1994
GB 2199978 A	20-07-1988	NONE	